

Denver, 46; Wichita and Kansas City, 45. The smallest values were: Key West, 13; Jupiter and Fort Canby, 14; Tatoosh Island, 15; Point Reyes Light, 16; San Francisco and Seattle, 17; Hatteras, 18; Astoria, 19; Walla Walla, 20.

Among the *extreme monthly ranges* the largest were: Lander and Pueblo, 98; North Platte, 91; Havre and Idaho Falls, 86; Helena, 85; Denver, 84; Cheyenne and Walla Walla, 80. The smallest values were: Key West, 17; Jupiter, 20; Point Reyes Light, 27; San Francisco, 28; Tatoosh Island, 29.

#### MOISTURE.

The *quantity of moisture* in the atmosphere at any time may be expressed by the weight of the vapor coexisting with the air contained in a cubic foot of space, or by the tension or pressure of the vapor, or by the temperature of the dew-point. The mean dew-point for each station of the Weather Bureau, as deduced from observations made at 8 a. m. and 8 p. m., daily, is given in Table I.

The *rate of evaporation* from a special surface of water on muslin at any moment determines the temperature of the wet-bulb thermometer; an evaporimeter may be so constructed as to give the *quantity of water evaporated* from a similar surface during any interval of time. Such an evaporimeter, therefore, would sum up or integrate the effects of those influences that determine the temperature as given by the wet bulb; from this quantity the *average humidity of the air* during any given interval of time may be deduced.

Measurements of evaporation within the thermometer shelters are difficult to make so as to be intercomparable at temperatures above and below freezing, and they may be replaced by computations based on the wet-bulb temperatures. The absolute amounts of evaporation from natural surfaces not protected from wind, rain, sunshine, and radiation, are being measured at a few experimental stations and will be discussed in special contributions.

*Sensible temperatures.*—The sensation of temperature experienced by the human body and ordinarily attributed to the condition of the atmosphere depends not merely on the temperature of the air, but also on its dryness, on the velocity of the wind, and on the suddenness of atmospheric changes, all combined with the physiological condition of the observer. A satisfactory expression for the relation between atmospheric conditions and nervous sensations has not yet been obtained.

#### PRECIPITATION.

[In inches and hundredths.]

The *distribution of precipitation* for the current month, as determined by reports from about 2,500 stations, is exhibited on Chart III. The numerical details are given in Tables I, II, and III. The total precipitation for the current month was heavy (6 to 11 inches) in Tennessee, Kentucky, and the mountainous parts of Georgia and North Carolina, but heaviest (14 to 27 inches) on the immediate coast of Washington, Oregon, and northern California. It was least, viz, a trace over a large portion of southern Nevada and the adjacent portions of southern California and Arizona. The larger values at regular stations were: Astoria, 16.6; Fort Canby, 15.1; Pysht, 14.5; Portland, Oreg., 13.1; Roseburg, 9.9; Seattle, 9.5. The smaller values were: Yuma, 0.1; Phoenix, 0.6; El Paso, 0.04.

Details as to *excessive precipitation* are given in Tables XII and XIII.

The *years of greatest and least precipitation* for November are given in the REVIEW for November, 1890. The precipitation for the current month was the greatest on record at: Roseburg, 9.91; Marquette, 6.44; St. Paul, 5.07; Spokane, 4.85; Duluth, 3.42; Helena, 3.29; Bismarck, 3.10; Moorhead and Walla Walla, 3.09; Williston, 2.10; Huron, 1.97; Pierre, 1.92;

Concordia, 1.78; Miles City, 1.37; Rapid City, 1.09. It was not the least on record at any regular station of the Weather Bureau.

The *diurnal variation*, as shown by tables of hourly means of the total precipitation, deduced from self-registering gauges kept at the regular stations of the Weather Bureau, is not now tabulated.

The *current departures* from the normal precipitation are given in Table I, which shows that precipitation was in excess throughout the northern half of the country and also in the South Atlantic States, Tennessee, and the Ohio Valley. It was slightly deficient over a narrow belt extending along the middle and the east Atlantic Coast as also from the lower Lake Region southwest to the Rio Grande Valley.

The large excesses were: Portland, Oreg., 7.3; Astoria, 6.8; Fort Canby, 6.6; Roseburg, 6.2; Eureka, 3.9; Marquette, 3.7; Spokane, 3.2. The large deficits were: Shreveport, 3.7; Palestine, 2.8; Corpus Christi, 2.7; Galveston, 2.5.

The *average departure* for each district is given in Table I. By dividing each current precipitation by its respective normal the following corresponding percentages are obtained (precipitation is in excess when the percentage of the normal exceeds 100):

Above the normal: South Atlantic, 114; Florida Peninsula, 127; Ohio Valley and Tennessee, 122; upper Lake, 139; North Dakota, 418; upper Mississippi, 114; Missouri Valley, 119; northern Slope, 230; middle Slope, 123; middle Plateau, 170; northern Plateau, 278; north Pacific, 171; middle Pacific, 158; south Pacific, 128.

Below the normal: New England, 72; middle Atlantic, 84; east Gulf, 92; west Gulf, 45; lower Lake, 75; southern Slope (Abilene), 42; southern Plateau, 56.

The *total accumulated monthly departures* from normal precipitation from January 1 to the end of the current month are given in the second column of the following table; the third column gives the percentage of the current accumulated precipitation relative to its normal value.

Districts.	Accumulated departures.	Accumulated precipitation.	Districts.	Accumulated departures.	Accumulated precipitation.
	Inches.	Per ct.		Inches.	Per ct.
North Dakota.....	+ 3.30	118	New England.....	- 3.60	91
Upper Mississippi.....	+ 1.70	105	Middle Atlantic.....	- 5.10	88
Missouri Valley.....	+ 1.00	103	South Atlantic.....	-11.00	78
Northern Slope.....	+ 1.30	109	Florida Peninsula.....	- 3.90	92
Southern Plateau.....	+ 1.30	117	East Gulf.....	- 7.00	87
Middle Plateau.....	+ 3.50	133	West Gulf.....	-10.30	74
Northern Plateau.....	+ 1.10	108	Ohio Valley and Tenn....	- 2.50	94
North Pacific.....	+ 7.00	114	Lower Lake.....	- 1.10	97
Middle Pacific.....	+ 4.20	117	Upper Lakes.....	- 1.10	97
			Middle Slope.....	- 1.40	94
			Abilene (southern Slope).....	- 3.90	83
			South Pacific.....	- 1.00	90

#### SNOW.

The total monthly snowfall at each station is given in Table II; its geographical distribution is shown on Chart V. This chart also shows the isotherms of minimum 32° and of minimum 40° for the air within the ordinary thermometer shelter. The former isotherm is an approximate limit to possible snow, while the latter is an approximate southern limit to the regions that report frost on exposed localities.

*Snowfalls* of from 5 to 15 inches occurred in Maine and New Brunswick; 20 to 30 in Ontario; 15 to 35 near Lake Superior and in the Dakotas; 20 to 100 on the mountains of Colorado; 15 to 50 on those of Montana, Idaho, and California; 20 to 115 on those of Oregon, Washington, and British Columbia.

The *depth of snow on the ground* at the end of the month is given in detail in Table II, and for the winter months is also shown on Chart VI. The condition of the snow on the

ground and of the ice in the rivers on Monday of each week is also shown on the weekly charts of the Climate and Crop Service, published by the Weather Bureau during December to March, inclusive. Special reports of ice are quoted in connection with the section devoted to the River and Flood Service.

#### HAIL.

The following are the dates on which hail fell in the respective States:

California, 22, 23, 25, 30. Indian Territory, 25, 26, 27. Iowa, 3. Louisiana, 3, 6, 28. Mississippi, 4. Missouri, 3. New Mexico, 25. Ohio, 5. Oklahoma, 25. Oregon, 12. Texas, 2, 25, 26, 27. Washington, 5. Wisconsin, 2.

#### SLEET.

The following are the dates on which sleet fell in the respective States:

Alabama, 29, 30. Arizona, 25. Arkansas, 19, 26, 27, 28. Colorado, 25, 26. Connecticut, 21, 22, 29. Delaware, 21, 29. District of Columbia, 20, 29, 30. Georgia, 21, 30. Idaho, 4, 5, 9, 10, 11, 13, 18, 19, 26. Illinois, 5, 10, 11, 19, 20, 27, 28. Indiana, 5, 20, 23, 26 to 29. Iowa, 9, 10, 16, 17, 18, 20 to 28. Kansas, 9, 10, 11, 17, 19 to 22, 24 to 27. Kentucky, 27, 28, 29. Louisiana, 30. Maine, 18, 26. Maryland, 8, 20, 29, 30. Massachusetts, 13, 21. Michigan, 4 to 8, 10, 11, 15, 18, 20, 21, 24 to 27. Minnesota, 2, 17, 23 to 27. Mississippi, 28, 29, 30. Missouri, 3, 4, 5, 9 to 13, 18, 19, 20, 23, 24, 26, 27, 28. Montana, 1, 8, 14, 15, 22. Nebraska, 17, 20, 22 to 27. Nevada, 23, 25. New Hampshire, 21, 25. New Jersey, 13, 21, 29. New Mexico, 9, 10, 11. New York, 13, 18, 21, 25, 28, 29. North Carolina, 1, 29, 30. North Dakota, 2, 3, 14, 15, 18. Ohio, 8, 9, 10, 12, 13, 20, 24, 27, 28. Oklahoma, 19, 27. Oregon, 4, 7, 10, 16, 17, 22, 23, 29, 30. Pennsylvania, 20, 21, 28, 29. Rhode Island, 13, 21, 29. South Carolina, 30. South Dakota, 1, 2, 3, 6, 24 to 27. Tennessee, 27 to 30. Texas, 29, 30. Vermont, 21. Virginia, 8, 9, 13, 20, 29, 30. Washington, 1, 4, 7, 9 to 12, 15, 18, 21, 22, 23, 27 to 30. West Virginia, 28, 29, 30. Wisconsin, 4, 10, 21, 23 to 26.

#### SUNSHINE AND CLOUDINESS.

The quantity of sunshine, and therefore of heat, received by the atmosphere as a whole is very nearly constant from year to year, but the proportion received by the surface of the earth depends upon the absorption by the atmosphere, and varies largely with the distribution of cloudiness. The sunshine is now recorded automatically at 19 regular stations of the Weather Bureau by its photographic, and at 31 by its thermal effects. At one of these stations records are kept by both methods. The photographic record sheets show the apparent solar time, but the thermometric records show seventy-fifth meridian time; for convenience the results are all given in Table XI for each hour of local mean time.

Photographic and thermometric registers give the duration of that intensity of sunshine which suffices to make a record, and, therefore, they generally fail to record for a short time after sunrise and before sunset, because, even in a cloudless sky, the solar rays are then too feeble to affect the self-registers. If, therefore, such records are to be used for determining the amount of cloudiness, they must be supplemented by special observations of the sky near the sun at these times. The duration of clear sky thus specially determined constitutes the so-called twilight correction (more properly a low-sun correction), and when this has been applied, as has been done in preparing Table XI, there results a complete record of the clearness of the sky from sunrise to sunset in the neighborhood of the sun. The twilight correction is not needed when the self-registers are used for ascertaining the duration of a special intensity of sunshine,

but is necessary when the duration of cloudiness is alone desired, as is usually the case.

The average cloudiness of the whole sky is determined by numerous personal observations at all stations during the daytime, and is given in the column "average cloudiness" in Table I; its complement, or percentage of clear sky, is given in the last column of Table XI.

#### COMPARISON OF DURATIONS AND AREAS.

The sunshine registers give the *durations* of effective sunshine whence the duration relative to possible sunshine is derived; the observers' personal estimates give the percentage of *area* of clear sky. These numbers have no necessary relation to each other, since stationary banks of clouds may obscure the sun without covering the sky, but when all clouds have a steady motion past the sun and are uniformly scattered over the sky, the percentages of duration and of area agree closely. For the sake of comparison, these percentages have been brought together, side by side, in the following table, from which it appears that, in general, the instrumental records of percentages of durations of sunshine are almost always larger than the observers' personal estimates of percentages of area of clear sky; the average excess for November, 1896, is 7 per cent for photographic and 4 per cent for thermometric records.

The details are shown in the following table, in which the stations are arranged according to the greatest possible duration of sunshine, and not according to the *observed* duration as in previous years.

*Difference between instrumental and personal observations of sunshine.*

Stations.	Apparatus.	Total possible duration for the whole month.	Personal estimated area of clear sky.	Instrumental record of sunshine.			
				Photographic.	Difference.	Thermometric.	Difference.
Tampa, Fla.	T	323.5	54	54	0	50	-4
Galveston, Tex.	T	321.7	51	44	-7	35	-1
New Orleans, La.	T	319.7	36	50	+14	35	-1
Savannah, Ga.	P	315.9	50	52	+2	35	-1
Vicksburg, Miss.	P	315.9	67	59	+8	69	+2
Phoenix, Ariz.	P	314.0	59	51	-8	51	-8
San Diego, Cal.	T	314.0	73	78	+5	49	-1
Atlanta, Ga.	T	312.2	59	59	0	60	+1
Los Angeles, Cal.	T	312.2	62	62	0	61	+1
Wilmington, N. C.	T	312.2	40	40	0	41	+1
Chattanooga, Tenn.	T	310.1	40	40	0	51	+11
Little Rock, Ark.	T	310.1	53	53	0	61	+8
Raleigh, N. C.	P	308.3	53	53	0	61	+8
Santa Fe, N. Mex.	P	306.3	69	85	+16	67	+9
Fresno, Cal.	T	305.7	58	58	0	67	+9
Dodge City, Kans.	P	304.0	59	62	+3	43	+12
Louisville, Ky.	T	304.0	51	51	0	50	-1
San Francisco, Cal.	T	304.0	51	51	0	49	-1
Baltimore, Md.	T	301.5	37	37	0	38	+1
Cincinnati, Ohio.	P	301.5	36	36	0	38	+2
Kansas City, Mo.	P	301.5	48	53	+5	46	+10
St. Louis, Mo.	T	301.5	36	36	0	46	+10
Washington, D. C.	T	301.5	44	47	+3	38	+3
Columbus, Ohio.	T	299.7	35	35	0	38	+3
Denver, Colo.	T	299.7	53	80	+27	50	+3
Indianapolis, Ind.	T	299.7	42	42	0	53	+11
Philadelphia, Pa.	T	299.7	41	41	0	53	+12
Cheyenne, Wyo.	P	297.3	45	66	+21	38	+3
Eureka, Cal.	T	297.3	41	43	+2	51	+12
New York, N. Y.	T	297.3	39	39	0	51	+12
Omaha, Nebr.	P	297.3	47	51	+4	43	+8
Salt Lake City, Utah.	P	297.3	23	43	+19	38	+3
Binghamton, N. Y.	T	294.9	26	26	0	36	+6
Boston, Mass.	T	294.9	31	31	0	37	+6
Chicago, Ill.	T	294.9	36	36	0	36	+6
Cleveland, Ohio.	T	294.9	20	20	0	26	+6
Des Moines, Iowa.	T	294.9	41	41	0	44	+3
Detroit, Mich.	T	294.9	27	27	0	35	+8
Dubuque, Iowa.	T	294.9	52	52	0	38	+4
Buffalo, N. Y.	T	292.3	21	21	0	23	+2
Rochester, N. Y.	T	292.3	25	25	0	34	+1
Northfield, Vt.	P	289.7	21	22	+1	23	+2
Portland, Me.	T	289.7	23	23	0	40	+11
Eastport, Me.	T	287.2	23	27	+4	23	+12
Minneapolis, Minn.	T	287.2	23	23	0	23	+12
Portland, Oreg.*	P	284.1	35	35	0	35	+12
Bismarck, N. Dak.	P	284.1	35	35	0	35	+12
Helena, Mont.	P	281.0	31	31	0	31	+12
Seattle, Wash.	T	278.0	31	31	0	31	+12